DOE Public Workshop

Silo 3 Path Forward

June 16, 1997

7:00 P.M.

at the Alpha Building

1

2 MR. STEGNER: Let's go ahead and get
3 started. Good evening everybody and thank you all for
4 coming. My name is Gary Stegner and I am with Public
5 Affairs for the Department of Energy at Fernald. If
6 you have not signed in, please do so. That way we
7 will be sure and get all of the mailings associated
8 with Operable Unit 4, particularly Silo 3. There is
9 a number of handouts I think on your chairs or tables
10 in front of you that includes an evaluation form. I
11 would ask if you would not mind filling that out at
12 the end of the evening and turn it in at the back
13 table. That has been the case at previous OU4 Silo 3
14 sessions, we have a court reporter here. We ask you
15 to speak loudly, clearly, if you don't mind, state
16 your name before you speak. We also, for the first
17 time tonight, we are video taping one of these
18 sessions, sort of an educational meeting and we want
19 to have this available in the PDIC for folks who are
20 not able to attend tonight but they will be able to
21 have access to the information that we are going to
22 impart tonight.
23 Let me show you, before we get going too much
24 further. Our public meeting calendar for the
25 forseeable future, what we would like to do if you all

1 brought your calendars tonight, maybe set times for
2 the next session here for Silo 3. Essentially this is
3 a second of what we hope to be a 3 part series and
4 we're trying to reach a concensus on Silo 3 and
5 hopefully by our next session next month we will be in
6 a position that we will be able to reach a concensus
7 on pathforward regarding the best possible solution
8 for Silo 3. What looks good for the folks here, are
9 Mondays workable for you all, do you want to go
10 Tuesdays, Thursday, basically, we are at your disposal
11 and you can essentially pick the date.
12 MS. CRAWFORD: 22nd.
13 MR. STEGNER: 22nd sound good?
14 MR. TABER: No.
15 MR. STEGNER: One in every crowd. Don't
16 worry Bob has already started coming that's a bad
17 start. July 22 it is then.
18 We mentioned last time what we are doing is at
19 the request of the citizens of Nevada, we are putting
20 on this same workshop for the steakholders that is in
21 Nevada as we are for ours here. The May 14 session we
22 had last time on the 3rd of June we put the same
23 workshop on for the folks out in Nevada, essentially,
24 basically the same material presented to you folks and
25 it went very well. They were very appreciative of it.

We got good feedback from them and our current plan is to repeat this particular workshop to the steakholders in Nevada on the first of July. By way of background, let me go ahead and give you a little background of what we hope to do tonight. On the next two hours, more or less, we do have a lot of information to try and impart to you tonight so we may go just a little bit long tonight but as you know I always try to end the meeting on time. The last meeting Dr. Paine presented a brief description of the universe of treatment technology that were potentially applicable to Silo 3. With your help we were able to pretty much weed that list down to about 3 or 4 and you asked for more information on those 3 or 4 but basically you wanted to know more about the chemistry of it, physics of it and essentially the science of the waste form that we would be hopefully creating, potentially creating from the Silo 3 materials. What we have done is we have elicited the assistance of Dr. Christine Langton from Westinghouse in Riverside. She has one of the complexes most authoritative voices on waste processes and what we have asked her to do tonight is essentially discuss the chemistry, the science of potential waste form that we would be creating from Silo 3 and I think there is 3 or 4 points that she

will be discussing tonight. What we did not ask Dr. Langton to do is recommend the best possible solution for Silo 3. That would not be fair to her nor would it be fair to you folks so she is here basically to discuss the science, the processes and that's all we asked her to do tonight. Kicking off the presentation tonight, Don Paine who is the primary presenter last time, will be giving a review of what we discussed on the 14th of May and that will be followed by Dr. Langton, Christine Langton and then Terry Higgins will try to draw a lot of what Dr. Langton has talked about and what Don has talked about and we can put it all into a Fernald perspective and try to bring everything together as it pertains to Silo 3. I'm trying to think if there is anything else I have forgotten. So, with that, I will introduce Dr. Don Paine.

MR. PAINE: Thank you Gary. Welcome to everybody tonight. It looks like a lot of familiar faces and a few new ones that are here tonight. I think as Gary already said this is like our second attempt, a kind of a continuing education process on technology that might be applicable to remediating the Silo 3 material that we have in the OU4 area. Just to recap a little bit from the last meeting we kind of went through this broad family of categories or

1 technology that would be applicable to the types of
2 material that we have in Silo 3 and then we went
3 through about 15 or so specific kinds of processes at
4 the last particular meeting and we kind of streamed
5 those down to a more manageable kind of number that we
6 could bring forth at this particular meeting and get
7 some more detail from any of you at those particular
8 processes from people that are familiar with, some of
9 the experts in the field. So Christine Langton will
10 be our primary speaker associated with those
11 particular processes that we brought forward.
12 Christine, as Gary said, is with the Savannah
13 Riverside, the Westinghouse folks down there and she
14 has a Bachelor's and Master's and a Ph.D. from
15 Pennsylvania State University. She has about 15 years
16 of experience in dealing with a variety of waste
17 remediation kinds of technology. So, we are real
18 fortunate to have her here tonight. We do have some
19 support personnel in the audience, relative to some of
20 the technologies, Earl McDaniel who is a member of the
21 IRT, the meeting that we brought in stabilization
22 experts associated with that particular effort and we
23 have two of the many Paul's who are the Brookhaven
24 National Laboratory -- seems like everybody up there's
25 name is Paul and we have 2 Pauls, Paul Calvin, most of

1 us are familiar with him, who is not one of these
2 Paul's but you might want to stand up a little bit and
3 say something about yourself so that we can see who
4 you are and yell at you.
5 MR. MOSKOWITZ: First I'd like to say
6 something very important and that is the New York
7 Yankees vs. the New York Metts, you Cincinnati bull
8 fans, this is the first time they played officially in
9 25 years against each other. My name is Paul
10 Moskowitz and I am head of the Environmental Waste
11 Technology Center. We have the patent on the sulfur
12 polymer technology and the polymer
13 microencapsulization. I brought some samples here
14 today and I would be happy to share with you some of
15 the experiences associated with these technologies and
16 this is Paul Lageraaer and he probably would like to
17 say something here.
18 MR. LAGERAAER: I am a chemical engineer and
19 I have been working on development of these
20 technologies of the polyethylene encapsulation and a
21 little bit of the polymers so if you have any
22 questions, if I can help you in any way, just ask me
23 some questions afterwards.
24 MR. PAINE: Okay, thanks. Well, just to get
25 on with this so that I can get down and get in to the

1 meat of this thing we have kind of gone through this
2 general category of technologies and we have kind of
3 gotten ourselves screened down into vitrification and
4 some form of stabilization, solidification kinds of
5 technology that we want to look at with emphasis on
6 the solidification and stabilization area with the
7 idea of what we're really interested in is from the
8 standpoint of the Silo 3 is the stabilization aspect
9 of that, not that the state of solidification is not
10 important, but our primary effort is to stabilize the
11 toxic metals that we have in Silo 3, the chromium, the
12 celenium that is associated with that particular --
13 the solidification stuff will certainly present
14 liquids (inaudible) like a solid waste form and like
15 to knock down some of the dispersability associated
16 with the alphamaic thorium 230 in the waste form so
17 that is what we are primarily going to be associated
18 with, with the vitrification, with those of you who
19 may be new, it is in our original interrog, it was a
20 remedy of choice that was chosen and the process of
21 the implementing of that particular thing. We had a
22 few difficulties, primarily in waste, Silo 3 material
23 is very high in sulphate concentration which makes it
24 very unfriendly in the vitrification process and also
25 just the implementability of the vitrification process

itself, as the production and kind of a scale. It's not unique to the vitrification technology in this country or worldwide. Most of the vitrification facilities in this country, just came on this last year, just like we did with our pilot facility so, we have some terms associated with that and we wanted to see what else was possibly available to deal with the Silo 3 material so, I guess with that, I'm going to turn it over to Christine and, oh, one other thing that I maybe ought to talk about is the, I said we talked about 15 or so other kinds of, individual kinds of processes and we kind of got it down to a family of cements stabilization solidification processes, cement like, not necessarily cement per se, and Christine will be talking about those families of technologies that are available and we understand that the Polymer and sulfapolymer encapsulation types of processes, they have been taken really from the laboratory aspect and have some degree of commercialization that have been associated with it.

There was a recourse at the last meeting relative to Phoenix Ash being considered and Christine will talk about that and the family of cement stabilization solidification aspects of it and there was another request that we might put on a ceramic

1 kind of a technology but we're not going to talk about
2 that tonight. We kind of screened it out initially
3 because it was still in the early phases of
4 development and really had not been taken to any level
5 of commercialization yet but we are certainly aware of
6 it at that particular point in time or we are aware of
7 it now but we kind of screened that one out based on
8 that so with that I will turn this over to Christine
9 and let her go with it.
10 DR. LANGTON: First of all, thank you for
11 having me here tonight. I was asked to come and
12 review waste treatment processes and particular
13 stabilization solidification encapsulation technology.
14 Please ask any questions that you might have and if I
15 cannot answer them, I will be happy to try and answer
16 them later and take them down and then get back to
17 you. In addition to the materials that I am going to
18 present here that is on the slides, we have brought
19 samples, starting materials that go in the waste
20 forms, both the cement sulphur and polyethylene that
21 are back on the table. We brought posters that show
22 experience with the cement waste forms, which are
23 operating processes and then we have a chart here that
24 is the summary of successes and failures within the
25 DOE complex. Because of the time constraints and

1 because any one of these topics could take a long
2 time, could take several days to discuss, we put them
3 up on the poster and what we're hoping for is that you
4 will take a look at them during the workshop or after
5 the formal presentation and discuss them to the extent
6 that you are interested in them. As far as successes
7 and failures, Harold McDaniel and I have been on
8 several day discussions reviewing these within the
9 complex and we are probably the right people to talk
10 about them. We have seen most of them or have some
11 sort of personal involvement in the reviewing process.
12 Now, just to give you an outline of what I am
13 going to talk about, first of all what I would like to
14 say, the reason we treat waste is first because we
15 want to conserve natural resources and that is done in
16 the waste treatment by recovering and recycling as
17 much as possible. If that is not possible, then the
18 constituents that are concerned and require treatment
19 to make them, to make their disposal in the
20 environment as low impact as possible. I will talk
21 about some other of these treatment processes and the
22 waste forms that are available for carrying out those
23 processes. Again, I won't talk about the experiences
24 formally, but we can talk at any length if you are
25 interested in the poster that I have up here and then

1 I will give you a brief summary of where things are at
2 and comparing these waste forms in particular.
3 The treatment that I am going to talk about
4 are stabilization encapsulation, solidification and
5 I'm not going to talk about vitrification. I put it
6 up here so that you can see where it fits in in the
7 picture.
8 Starting with these stabilization, what it
9 really involves is chemically reacting contaminants
10 with reagents, with chemicals to form insoluble and
11 low soluble compounds. The EPA has identified
12 stabilization for toxic metal waste. The waste here
13 at Fernald shows the characteristic of metal toxicity
14 and four metals, arsenic, cadium, chromium, and
15 celenium. So, stabilization as it is conventionally
16 practiced has been identified by EPA as the best
17 development available in technology.
18 Encapsulation is the process which is carried
19 out with the objective of physically isolating the
20 contaminants in the environment. There is barely a
21 chemistry involved as far as reacting compounds to
22 form most solidification. Now, encapsulation PA has
23 the best developmental technology for radioactively
24 contaminated debris so equipment, processing vessels,
25 piping, that is contaminated with both radionuclei and

1 has its constituents has been identified for suitable
2 for macro encapsulation. Encapsulation has also been
3 identified as an alternative treatment for toxic metal
4 waste.
5 Solidification is a different type of process
6 even though the word is often used in conjunction with
7 the first two. The objective of solidification is to
8 convert a liquid to a solid or to convert fine powder
9 into non-dusting or solid or larger objects so to make
10 them into spill proof or dust proof really.
11 Solidification is not the best developed technology
12 for any hazardous waste but the solidification which
13 is required for wet waste of any kind to go into a
14 landfill so it is a treatment that is performed at
15 Savannah River. We do solidification of non-
16 hazardous, non EPA regulated basin sediments that
17 might have a small amount of radioactivity in them
18 because we are not permitted to dispose of liquid
19 waste within our landfill. They have to be solid, but
20 we don't do any fixation of the contaminants.
21 Now, vitrification is a technology where the
22 waste and glass or other agents, other silicates
23 ingredients are melted at elevated temperatures to
24 form a glass waste form and this particular waste
25 form, the metal constituents in a non-volatile radio

1 nuclei are chemically bound in the structure of the
2 glass so let's say lead is bound to oxygen and oxygen
3 is bonded to silicone so the waste is not present as
4 a separate crystal in phase in the glass. The glass
5 has not devitrified, it is not crystallized but it is
6 there as an intrecal constituent of the overall glass
7 structure. Now, vitrification is identified by the
8 EPA as the best developed available technology for
9 high level waste. There are three sites in the United
10 States that have high level waste. Savannah Riverside
11 would be one of them. We have a defense waste
12 processing facility that consists of two and a half
13 billion dollar vitrification operation which processes
14 less than 5% of our high level waste and making 95% of
15 our high level waste is decontaminated and then it is
16 run through a vitrification process.
17 The overall picture for this processing
18 facility is on the poster board in the back and I
19 don't have one, a photograph of our melter building,
20 but it is on the process flow diagram. There is a
21 picture of our solidification operation. We call it
22 salt stone. The other places in the country that have
23 high level waste and will be doing vitrification are
24 West Valley, New York where commercial sent fuel was
25 reprocessed for a short time and they had a facility

which has similar waste as Savannah River.

Now, to tell you a little bit more about the stabilization process, the objective here is to chemically reduce the contamination ability. This can be done by chemical reactions which are precipitation reactions, kim absorption exchange, there are some others ones that I can put up here, solid solution formation, precipitation, but again, the idea here is to chemical alter material so that when it comes in contact with water and the environment, with leachate, the mobility of the other contaminants is greatly reduced compared to what it is now in the country. Solids, liquids and sludges, sludges are a mixture of solids and liquids are treated with a stabilization process. The typical material are the reagent chemicals. This is commonly done in the waste water treatment business, aluminum sulfate, iron sulfate are standard waste water treatments, solidification, chemicals. They can also be added to waste before they go into cement waste form or into any other type of waste form in a pre-treatment process or the chemicals can be mixed in with the cement waste form as long as they react in the presence of water. We call that insitu treatment. The salt stone process is an insitu process where the reagents in the blend of

1 the right solids that are mixed into the waste have
2 the right chemistry to stabilize chrome and mercury.
3 The tests that are done on stabilized waste
4 form, the TCLP test. That is an EPA test that
5 evaluates whether or not the leachability has been
6 reduced or the contamibility has been reduced. The
7 TCLP test is a test that requires samples, less than
8 3/8 of an inch in size. The samples materials have to
9 pass a 3/8 inch siv. I have a couple of examples and
10 there are some others back at the table but this is
11 the cement waste form from one of my tests that was
12 prepared to go through the TCLP test. We can see it
13 has been crushed. We take a representative sample
14 that includes all of the larger pieces, but they all
15 these pieces pass the 3/8 inch test. Other tests were
16 the paint filter test. Paint filters are used by
17 painters to strain out the dirt, strain out the dirt
18 that might have gotten into the paint. It liquid
19 comes out of the paint filter, then the waste is not
20 considered a solid. If there is no liquid that comes
21 out of the paint filter, the waste is considered a
22 solid. And then particle size because again, that can
23 be a problem and there is no standard test for
24 particle size, but the particle size limit is very
25 small so this material would definitely pass with

1 respect to the particle size.

2 The next process is, that I would like to talk
3 about is microencapsulation. This process, the
4 objective is again to physically isolate the
5 contaminants. Liquids, solids and sludges can all be
6 encapsulated and at this point I have broken down the
7 types of materials used for microencapsulation. Those
8 used on dry waste and those that are used on wet
9 waste. For dry waste, polyethylene, sulfur, epoxy, or
10 a mixture of cement and water can be used. And here
11 again, the idea is to again, to trap the contaminants.
12 The types of samples that are made for the
13 microencapsulation objective are usually a little bit
14 different. This is part of a sample from a 200 gram
15 batch that was crushed up. This is 100 grams of it
16 and it was made in a model form, but typically for the
17 microencapsulation, small samples are made that
18 already passed the 3/8 inch siv for the TCLP test.

19 Now, the wet waste, I put cement down here as
20 a material that is most commonly used. Polyethylene,
21 sulfur, epoxy, these materials would also be used as
22 long as they were pre-treated and dry. The tests are
23 the same because the objectives are the same as the
24 alternative treatment for stabilization.

25 Solidification does not require any reduction

1 in contaminant ability. It is just done to make the
2 material, make the waste spill proof and dust proof.
3 Again, you can imagine what materials are suitable for
4 solidifying driveways. It would be the same,
5 polyethylene, sulfur, epoxy, or cement plus water.
6 What waste, typically cements are used but, absorbants
7 can also be used. I really shouldn't say, cements are
8 not the typical material used here. Most of the time
9 absorbants are used, bent night clay, some organize
10 absorbants, I have examples of organic absorbants but
11 another process that is commonly used here with wet
12 waste if the objective is to solidify is evaporation.
13 Actually evaporation was what was used on the Fernald
14 waste when it was calsigned to 600 degrees C to be
15 treated and it was more than evaporation, it was heat
16 treated to 600 degrees C. So, since leaching is not
17 an issue here we are only looking at whether it is
18 liquid or how big the solid matters are.
19 Now, the information that is required for the
20 overall waste form design is the same for all these
21 waste forms including vitrification. It is well
22 characterized waste, the kind of characterization that
23 is needed for some of these processes is different
24 than some of the others and it is important to have
25 the waste characterized and proper terms for the

1 treatment and technologies that are being considered.
2 Knowledge of cement waste interactions because the
3 cement waste involves chemical reaction. The other
4 two processes, solidification involves drying the
5 material usually, but they are not really chemical
6 processes and I'll explain that a little bit more.
7 You need an understanding of mechanisms for
8 controlling performance, knowledge of regulatory
9 requirements, experimental results and treatability
10 study are very important. We would not attempt any
11 sort of treatment without a good handle on the
12 treatability studies.
13 Now, at this point of the talk I am going to
14 move on to talking specifically about materials used
15 in these technologies. On this slide I put some
16 cement types of materials, materials containing cement
17 on this slide just to put in perspective of what we
18 are talking about. Cement plus sand plus water is
19 referred to in the construction industry as mortars
20 and grouts, depending on how fluid they are. The more
21 fluid they are usually they are referred to as a
22 grout. You can see that water is required to react
23 with the cement and a cement is the matrix that holds
24 together the aggregate which is sand. The amount of
25 cement in the mortar or grout is very small. It is

about 10 or 20 waste percent so, if you think of the sand as being your waste and I want to talk about waste any more at the top, but as you can see the materials that you are familiar with that function in the construction industry only have the cement present as the glue holding together other particles or for waste particles. Concretes and mixtures of cement and water plus fine and coarse aggregate and again the cement makes up 10% of the overall mix. Waste forms can be made with the mixtures of cement plus wet waste, sludges or solutions or they can be made with a mixture of cement and water plus dry waste. Again, the objective of the cement is to carry the chemicals required for the stabilization process and to glue those particles that are formed together and to a non-dusting solid. Now, all of these materials are commonly used with a variety of mineral additives, a variety of processing additives and again chemical or other materials that affect the overall end product of the final material. So, some of these materials are put on the slot and this is just some of them, certainly not all of them. Hydraulics cements are those that react with water and one sample that I brought as a sample of a cement klinker, limestone and clay are mined in a query and crushed and reacted as

1400 decrees C. in a cement kiln and that is the klinker and that material was crushed up to very fine particles. There is a sample of that in the back. That material because it was formed at high temperatures and because of its nature, it's crystal structure is unstable in the presence of water so when water is added to it, it reacts to form a unique type of hydrated product. It does not form into individual grains like sand grains, it forms a material that acts like a glue and its binder combined material combines aggregates or waste materials together. There are several types of hydraulic cement and I have only listed a couple of them. Portland Cement was made by the process that I just told you about, limestone and clay or limestone shale were mixed together for a two-part presses. Cement is old material. I did a study twenty years ago in Greece and Rome and these materials were used, the same types of materials except in ancient times a single rock, rocks were identified, they have all of the right minerals already in them. It was not a two part process so a single rock was fired and then crushed up and used as the glue to glue together the rocks and those materials were typically used as mortars and plasters or something a little thicker than paint. They were

1 not used in the construction business which developed
2 in ancient Rome because there was no good building
3 material in Rome so they made their own concretes. It
4 was a man-made sedimentary type of rock and I have an
5 example of that back there also. Anyway, there are
6 slag cements from material down at the river, slag, a
7 very important material and again it reacts with the
8 presence of water and calcium hydroxide. It forms
9 similar types of bonded phases as the Portland Cement.
10 There are calcium aluminum sulfates cements that are
11 referred to as shrinking compensated cements, gypsum,
12 limes, magnesium oxides and there are reactive mineral
13 additives, fly ash and natural mineral additives. The
14 romans used their volcanic ash soil and that mixed
15 with the lime produces the same types of binded phases
16 that are formed in Portland Cement. There is a whole
17 variety of chemicals. The one material that we are
18 making over in Savannah right now is we are adding
19 sulfate to calcium sulphite to achieve the chemical
20 reaction that we are trying to get. We are doing that
21 to get the reaction.
22 Now, these materials are combined in licensed
23 products, patented products, some of the products you
24 might have heard of include Phoenix Ash, Environstone,
25 Aquoset, there is a Mag Ox process and what it is is

1 just a combination of these materials formulated from
2 the manufacturer's of constructions, which carry out
3 certain things, certain chemical reactions. Now, the
4 whole idea with designing a cement waste form is to
5 select the proper cementing materials, mineral
6 additives, processing additives and stabilization
7 reagents to produce a material which makes production,
8 storage, transportation and disposal requirements.
9 This multi-component system that makes it a little bit
10 different than the encapsulation process that we
11 talked about a while ago. Some advantages and
12 disadvantages of cement waste forms include, the
13 advantages would be is that they can be tailored to a
14 variety of means including selective materials,
15 selective processing to achieve stabilization that is
16 required for the particular needs. It is mainly a
17 temperature process, there is no off gas needed. The
18 materials can be re-worked, silos restabilized. There
19 is a broad base of experience and materials are
20 available. There are vendors in this business in
21 particular there are a lot of vendors working the
22 environmental restoration field doing stabilization
23 and waste water treatments. We have a big process at
24 Savannah River and Oakridge has a, historically has a
25 large scale process and in our case at Savannah River

1 and in most cases the cement stabilization is used for
2 wet waste for a one-step process and solidification
3 stabilization at the same time. Some disadvantages
4 are the cement hydration sensitive to the waste
5 chemistry or the waste compensation and if the
6 composition is not right, the material may not
7 solidify, it may not set and this has happened and
8 been the source of quite a bit of failures. In a lot
9 of cases it was not because the waste in a particular
10 chemistry but there could be a whole list of reasons
11 why this material failed. QA issues from multiple
12 component systems, the ingredient system is a little
13 bit more difficult than with a similar system. There
14 is dust control problems but it is required and we do
15 have that worked out in one of our processing centers
16 in Savannah River and the other one is a dusting
17 process and it is not a radioactive process. The
18 potential bleed water, again with good engineering we
19 should be able to eliminate that. It does eliminate
20 it. We don't have big water in any of our material.
21 At Savannah River we are filling a high level waste
22 tank, a 1.6 million gallon tank right now. It's the
23 first time a waste tank has been closed in a complex
24 and we designed a rather special blend of add
25 mixtures, processing add mixtures that eliminate bleed

1 water. We have material that is easily mixed,
2 comparable, durable, it is pumped 1500 feet and there
3 is absolutely no bleed water, which is one of our
4 requirements, that is our biggest requirements. We
5 achieve that with a special mix of dispurcents to make
6 the material flow better, flow with less water and
7 with gum which you find in some foods and again, it is
8 used for the same reason, to give a consistence
9 homogeneous texture. Cements hydrate through reaction,
10 chemical reaction and those reactions do give off heat
11 and they do not, waste forms do not have to re-design
12 to control that heat. The density of the cement
13 additives and mineral additives is around 3, so it
14 does make for a heavy waste. You will see that if you
15 pick up the sample in the back that the cement waste
16 forms are heavier and then throughout the complex
17 there has been a polymer container corrosion. Now,
18 that is not necessarily strictly related to cement
19 waste form, that is what the complex has. It had been
20 in drums and the drums had been in storage and
21 weathered for years and in a lot of cases, there is a
22 corrosion problem. That does not mean the other waste
23 forms would not have corroded drums. We just don't
24 have any as other waste forms.
25 Now, I'm going to move on to polymer

1 materials, I'm sorry, sulfur materials and the folks
2 from Brookhaven, they brought some additional
3 information and then they can talk to you in more
4 detail about it. I am just hitting the high points
5 here and that is to say that the sulfur polymer
6 material that was developed in the 1970's by the U.S.
7 Bureau of Mines and the sulfur industries and what
8 they were looking for was a way to use by-product
9 sulfur which is generated in petroleums. The reason
10 that it is sulfur as it is, just an elementary sulfur
11 is not all that useful of a material is because if it
12 is heated up and cooled, it is very brittle material,
13 it cracks and falls apart and it certainly is not a
14 cementing type of material but these folks found if
15 they used two organic additives, siclopendine and
16 disiclopendine that they could prevent the face
17 transformation in sulfur which resulted in the
18 cracking, the shrinkage and cracking so the process
19 involves taking elemental sulfur with additives,
20 melting it at 130 degrees C. and then cooling it in a
21 modified sulfur material which we call sulfur polymer
22 resolve and this material is cemented, it does not
23 glue together aggregate or sand or waste particles in
24 a very good way. The whole process was adapted for a
25 waste encapsulation by DOE and in particular by the

1 folks here and in particular by the Brookhaven people.
2 I think Paul Lageraaer is the most instrumental in
3 doing that work.
4 Now, some advantages and disadvantages of the
5 sulfur polymer material is that solidification is
6 assured. You take powdered sulfur and melt it and
7 cool it and you get a material that is a solid. When
8 it is hot in a multi-stage of a liquid, it is cooled
9 and it is a solid. So, solidification is a sure
10 thing. It does not involve any chemical reaction like
11 the cement. It is compatible with many types of
12 waste. It is rapid hardening when it cools down, it
13 is resistant to a lot of chemicals. Actually the
14 material that was developed by the Bureau of Mines of
15 the sulfur institute was a sulfur concrete where the
16 molten sulfur was mixed with sand and gravel and used,
17 I have seen it used in the sulfuric acid plants and I
18 think it was in Louisiana. It is very resistant to
19 acid and an excellent material and I don't know of any
20 other material that is as good in that application so
21 it is being used commercially as a specialized
22 concrete building material. There is no gas generation
23 due to radiation or any radiation field. There is no
24 free liquid as it has low leaching and re-working and
25 besides reduced, it would be, I don't know why you

would want to do that, but I guess if it did not pass the TCLP test, which is possible and it would be size reduced to be melted. Some disadvantages, you can't use this process for wet waste. The waste has to have less than 1% evaporation water. Particularly the waste is pre-heated to make the mixing with the sulfur and melting of the sulfur better but the processes do have an off gas system that has to be designed. The sulfur polymer material does soften above 90 degrees C. and there is limited waste processing experience, but there is experience, there is some limited waste processing. SEG in Oakridge has done a little bit with the process and as far as using sulfur polymer and concrete, that is existing construction material.

The last material that I am going to talk about is the polyethylene material. And polyethylene is an organic polymer that was developed in the 30's. Low density form is what is used for the waste form process and there is an example of the starting material. There is pellets and shredded polyethylene waste and the idea here is to take the pellets and mix them with the dry waste and put the mixture into the extrusion melter. That melter is used in polymer production business, not polymer, in the manufacturing business to make objects, plastic objects,

1 polyethylene objects. It is well known equipment and
2 technology and here that mixture goes through a
3 multiple stage extruder where at the highest
4 temperatures it is about at 150 degrees C. This is a
5 melting stage. The pressures from the extruder would
6 go about 1500 PSI and melting temperature and
7 softening temperatures of the polyethylene depends on
8 the pressure also and it is used to both squeeze out
9 the air out of the volume and then it helps in the
10 melting and the resulting product of the polyethylene
11 encapsulation is the waste form and again, there are
12 samples in the back. In addition to the polyethylene
13 encapsulated waste, there is one sample of a
14 microencapsulated object in polyethylene, both micro
15 and macro encapsulation and today I will be talking
16 about the micro because that is what applies to the
17 fernald board. Now, the advantages again of producing
18 the polyethylene waste forms, the materials is inside
19 of the waste chemistry. The polyethylene does not
20 interact with the waste at all. The polyethylene
21 product and waste form could be designed to have
22 different compressive strengths, melting temperatures,
23 softening temperatures, by selecting the polymer. The
24 polymer comes in a variety of molecular waste and this
25 is something that would not be done by the waste form

1 engineer so the material can be or the end product can
2 be adjusted to some extent. There is no chemical
3 interaction, like I said, to get to the solidification
4 and re-work as possible. Again, all that has to be
5 done is the material size reduced and put back into
6 the melter.
7 Some disadvantages, for example, some of them
8 are paying for the sulfur, the waste has to be dry.
9 If it is not dry there is a potential for foaming.
10 The gases have to be removed from the extruder but not
11 necessarily through an elaborate off-gas situation.
12 The gases that are generated are the air that is being
13 squeezed out of the waste form. There is a processing
14 hazard above 350 degrees C. but the process operates,
15 as you saw before at less than 150 degrees C. so this
16 would only apply in the case of processing excursions.
17 There is no production scale experience with the
18 microencapsulation polyethylene but the
19 macroencapsulation using polyethylene is being
20 conducted out of Environcare for packaging objects.
21 Contaminated equipment, it is done two ways, one is
22 the type of encapsulation that you see in the back up
23 of a room and the other is to seal objects degree
24 pieces of equipment and polyethylene tubes and both
25 qualify because macroencapsulation is the best

1 developed technology for radioactive and hazardous
2 waste contaminated degree.
3 A disadvantage I put in this column is there
4 is no stabilization of any soluble waste. If there is
5 no chemistry involvement in this process, it is
6 strictly in an encapsulation process. This could
7 almost go in the advantage column because without any
8 chemistry it makes the process insensitive to
9 differences in the waste.
10 Now, to summarize all of this on this slide,
11 I have listed waste processes and waste forms.
12 Chemical stabilization of metals can be accomplished
13 in a cement waste form or sulfur waste form but it is
14 not really accomplished in polyethylene waste form as
15 the process begins. In order to get stabilization
16 with polyethylene waste forms, I think you would want
17 to pre-treat your waste first to carry out the
18 chemistry ahead of time and then microencapsulate it.
19 They do get microencapsulation a physical entrapment
20 of waste particles by all three of these materials.
21 You do get solidification or powder of all three of
22 these materials. Solidification liquids can be
23 carried out in some mid-waste forms just in the
24 process of making cement by the liquids water but the,
25 for the sulfur and the polyethylene waste form the

1 materials have to be pre-evaporated.

2 Now, there are a couple of issues that I have
3 not really addressed because they were complicated
4 issues and I tried to summarize some of them here in
5 terms of are maybe a little different than what you
6 are used to be thinking of. One has to do with volume
7 increase. The reason this is a complicated issue is
8 because people talk about waste floatings. A lot of
9 time they are talking about the waste matrix plus the
10 contaminants plus water without water or without the
11 matrix and people don't often compare apples and
12 apples on this one. So I tried to do something even
13 on a simple level and just say that the dry waste, the
14 volume increase is usually less than 20%. For wet
15 waste, because the water is in the wet waste or for
16 cement waste forms, which then contains the water, it
17 is usually less than 50% and that's a case for our
18 Savannah waste form. We have a 30 waste percent
19 solution and we get less than 50% volume increase.
20 For the sulfur and polyethylene which have to be pre-
21 dried, for wet waste we have to take into account the
22 other process, that is handling the waste treatment
23 and that would have to be defined and evidently what
24 we are talking about, to get a real volume change. A
25 lot of times this volume, the volume change the water

with some traces of an amount of contaminants that go through the waste water treatment system which generates the sludge and then it has to be processed and the water goes out.

Long term protection of the environment that I wrote this down, mechanism, rather than say how many years is this going to last because a long term protection of the environment involves two things. It involves the waste forms and the disposal site. It is a system and they work together so to eliminate especially how they work together because that is a large discussion, I have broken it down into mechanisms. The cement base forms, if they are engineered properly and if they are designed with the objective of the stabilization they form an insoluble precipitant for the contaminant concerned and then they carry out a physical entrapment of that contaminant also. Even in particles of size reduced to this level there is still a physical entrapment but the bulk of this stabilization that is being carried out here has been done chemically. In the case of the sulfur material, certain metals can be handled by chemical stabilization. Those metals form sulfides so you can have cadalene lead mercury sulfide in varying sulfide form but again they don't form to a large

1 extent in this process. The process is not designed
2 to get sulfide precipitation but it is possible. Most
3 of the treatment is by physical entrapment and again
4 for the polyethylene, most of the long term protection
5 provided by that physical entrapment.
6 The decontaminants, there are many
7 contaminants that can be handled by the cement waste
8 form. The metals, the forms sulfide are the ones that
9 are mainly thought of as being chemically stabilized
10 but also other contaminants can be handled by an
11 entrapped form of the sulfur. Again, you can trap many
12 types of contaminant and waste are compatible with the
13 polyethylene.
14 Another big issue that is difficult to discuss
15 is cost. One reason it is difficult is because --
16 well, costs for me are really very difficult but in
17 the case of cement, there are vendors out there that
18 are doing this, especially on the environmental
19 restorations projects in the commercial section. The
20 idea of going out for competitive bids through vendors
21 should give you a cost that is justifiable and
22 compares with industry standards. The sulfur and the
23 polyethylene processes are currently are not being
24 used as commercial processes in a marketed sense by
25 vendors soliciting waste streams, but both of these

1 materials are waste forms, and in the next few months
2 or a year may be available and prices may be available
3 so it would be possible to determine their cost.
4 Again, for the last two the cost of any waste water
5 treatment and secondary waste generation would have to
6 be dealt with.
7 Okay, my overall conclusions after working
8 with these materials, especially with waste treatment,
9 treatments for waste which is mostly what I did at
10 Savannah River sludges and solution, we also did some
11 debris treatment I was talking to the representatives
12 from Brookhaven and all three of these waste forms and
13 waste treatment processes can be designed to meet the
14 disposal requirement. Many waste treatments,
15 including Fernald Silos 3 and all of the waste
16 treatments can be poorly designed in processing
17 storage or disposal failures even at the Silo 3 waste
18 so good engineering is required from this point out.
19 Are there any questions?
20 MR. STEGNER: I'll tell you what, Terry has
21 about a ten minute presentation and we'll try to bring
22 some of his stuff together and put it in a Fernald
23 perspective so let's let Terry go ahead with his and
24 then we'll bring Christine back and Paul from
25 Brookhaven and also we'll have Earl back there also

1 and add something to the conversation also so let's go
2 ahead and let Terry finish his us and then we'll go
3 the rest of the evening, about 45 or 50 minutes with
4 questions.
5 MR. HAGEN: What I am going to present are our
6 thoughts on a comparison analysis on four
7 alternatives, vitrification with off site disposal and
8 cement stabilization with off site disposal, sulfur
9 polymer encapsulation with off site disposal and
10 polyethylene encapsulation with off site disposal and
11 before I do that I would like to do a few types of
12 background discussions and one is to kind of put this
13 in context with the process that we've laid out in the
14 last workshop. There were several public
15 involvements, the first of which would come to
16 consensus of come technology of the performance
17 requirements that we are going to use for the
18 treatment of Silo 3 and what I proposed was placing a
19 process similar to the feasibility process that we
20 went through successfully five times already. The
21 first part of that was to establish the remedial
22 action objective for what we are trying to accomplish
23 for treatment and then given that understanding of
24 what we are trying to do a treatment, look at the
25 universe of potential alternative using the fact of

1 this implementability and cost and that is what we did
2 the last time and that was the first stage of that
3 process that we went through and where we are at
4 tonight is now that we toned that done to a more
5 manageable group of the four alternatives, we're going
6 to present our thoughts on how those alternatives
7 stack up against the circle of 9 criteria which again,
8 as you recall was the next stage of the process.
9 We've got the detailed evaluation which we employ this
10 particular criteria and in terms of the objectives for
11 tonight, really what we are looking for his your
12 feedback on what I'm about to present. Those
13 thoughts, because that is what is going to go directly
14 into the ESD document, that goes into the report,
15 whatever type of technology or performance
16 requirements we select. What we would like to do the
17 next time in July workshop here that Gary talked about
18 is to propose to you an idea as to what the technology
19 performance requirement should do and again it's going
20 to be based on what I am about to summarize so again,
21 think about what we are saying. We're not expecting
22 you to digest it all tonight. Let us know if you love
23 it or hate it and like I said, we would like to hear
24 your comments on what your thoughts are in July, in
25 the meantime you start to develop ideas or questions

1 as to what I'm going to say, Gary wanted me to make
2 sure that they're passed on and feel free to call him
3 with those comments if that is what they are,
4 questions if that is what they are and they'll
5 probably better prep us to get to where we would like
6 to go in July.
7 The second part of the background is what are
8 the cercla "nine criteria" and I know a lot of you in
9 the room are very familiar with them. We have used
10 them so much, what I would like to give about a one
11 minute summary. They are broken down into three
12 groups, threshold criteria, which are overall
13 protection of human health and the environment
14 compliance with the applicable or relevant appropriate
15 requirement and they are called threshold
16 requirements, because the EPA guidance says you cannot
17 select a remedy unless you can show that it adequately
18 addresses these two so before you can even get to the
19 rest of the balancing and modifying criteria, you have
20 to have some basis for saying you adequately address
21 these so I don't want to say pass or fail, but in some
22 sense it is quite of a pass or fail. You have or show
23 an alternative to that. If you have a group of
24 alternatives that you can demonstrate in these special
25 criterias and then you really get to see what is the

1 meat of the comparative evaluation and that is trade
2 offs among these five balancing criteria. Going back
3 to the SF process again as we went through, usually at
4 this point in a process we only present our thoughts
5 amongst these first seven. The reason being is that
6 the post plan stage of the processes where the public
7 had a formal opportunity to comment on a proposed
8 remedy and where the state acceptance and the
9 community acceptance would be more clearly identified
10 and evaluated and kind of link that to our process
11 where we see that coming in and again we will give you
12 a graph explanation of the significance of this
13 document which is going to say what we think we should
14 do and why and you're going to comment on that and
15 that is kind of like the proposed plan of this stage.
16 We will have to identify some public comment and we
17 will get your comments and just like in the
18 _____ stage where the DOE committed and in
19 fact had developed a written response saying how they
20 were addressing each others comment so that is where,
21 really that is more of an evaluation than the usual
22 comment.
23 Okay, these again are our thoughts as to how
24 these alternatives stack up for which we are inviting
25 your feedback on the threshold criteria, overall

1 protection of human health and the environment, we're
2 kind of piggyback on Christine's presentation. If the
3 alternatives function as designed and as theory says
4 they can function, basically we will leave all four
5 which will be adequately protected with human health
6 and environment. If you look at the kind of risks
7 that are posed, the short term type risk or the
8 transportation type risk really addressed their
9 combination of two things. One is the treatment
10 itself which for the transportation issues we will
11 really address the dispersibility of this
12 contamination. Let's say in an accident scenario
13 because it's a very fine particle size type of
14 material combined with the material that you would
15 ship this material into an off site disposal location
16 and that is something that is common to all four
17 treatment technologies and alternatives. And then as
18 far as long term effectiveness is concerned, again, a
19 combination of the treatment which in this case
20 basically addresses the contaminant mobility or the
21 RI/FS metal issues combined with the disposal and the
22 engineering facilities in the area environment. I
23 will come back to that particular point on the next
24 slide but in essence, we think that all four, if they
25 function as designed and can now provide for

1 protection of the human health in the environment. As
2 far as compliance with the ARARS, I think if you go
3 back to the ARARS that are identified in the Operable
4 Unit 4, we would not anticipate having required an
5 exemption or a better way to say it is that we believe
6 that all four of the alternatives can comply with what
7 has been identified as the ARARS so what that says is
8 we think that all four alternatives are okay to take
9 forward to this balance and criteria and carry it to
10 the evaluation. You are kind of looking to trade off
11 among them.
12 Okay, balancing criteria. Long-term
13 effectiveness and permanence. Our thought on this is
14 that there is no really major distinguishing factor
15 among any of the four alternatives on this criteria
16 and that is basically because as I said the
17 alternative and as Christine said it's a combination
18 of two things, the treatment and disposal. Really
19 what we think provides the governing level of
20 protectiveness here is going to be disposal at an off
21 site area, disposal location such as NTS or
22 Environcare where basically you don't have any
23 residential type receptor, there are no ground water
24 concern and the materials that is being placed in the
25 engineer disposal facility with institutional controls

1 to address things like inadvertent attrusions and
2 things of that nature so because of really the
3 governing protectiveness that is provided by that part
4 of the alternative, it is our thought that there is
5 not a major distinction among any of the four so this
6 is probably not going to be the basis at least from
7 our perspective in identifying one thing or another.
8 Short term effectiveness is really made up of
9 three different things, worker protection, their
10 implementation of the remedial action period,
11 protection of the public during the implementation of
12 remedial action and that is not only local residents
13 around here but also it has to do with the
14 transportation risks and finally the type of
15 protectiveness, which is just another way to say how
16 long will it take you to complete the clean up. Okay,
17 working on Christine's presentation, we believe that
18 the worker risk are somewhat higher for vitrification
19 and encapsulation technology because the higher
20 operating temperatures it's an instabilization,
21 basically and doesn't involve some of those types of
22 operating risks. In terms of actual exposure to
23 contaminants, I don't really see any distinguishers
24 between any of the four there so from that perspective
25 it looks like cement stabilization would have a slight

1 advantage. As far as calculated transportation risks,
2 you have to remember the OU1 process where we talked
3 to you and we went through the quantitative calculated
4 estimates of the risk associated with transporting
5 this stuff and we have done that for all four
6 alternatives with some assumptions as to how the
7 polymer sulfur encapsulation were formed and basically
8 all four of those present risks that are well below or
9 better than -- U.S. EPS guidelines there and that's
10 where the 110 minus 60 comes from. You can make the
11 statement that perhaps transportation risks would be
12 the lowest for vitrification because of the smaller
13 volume of waste transported and hence a lower number
14 of waste shipments can in talking to Christine and the
15 regulators, there is an uncertainty there, perhaps a
16 significant uncertainty and basically it comes back to
17 the sulfite issue which you heard before and that they
18 have a 17% sulfite -- sulfates in Silo 3 and to
19 implement vitrification successfully, industry
20 experience as well as a pilot plan shows to get that
21 down to 1/2% and there's one of two ways that you can
22 do that. You can dilute the hell out of it with other
23 low level type wastes from on site and basically take
24 the sulfate concentration for 17% down to 1% or you
25 can see what are called the duckstand, which I could

1 not explain if I had to but it would take a
2 significant amount again for the objective of adding
3 those which is to control the product associated with
4 the sulfate and what that means is you are adding
5 enough material that it might fall into question and
6 rather that if you look at the volume that are
7 starting within the waste Silos whether you are
8 actually going to end up with a reduction of volume
9 and one thing is clear whenever you take a certain
10 block of material and put it in the melter, you are
11 going to come out with less than you put in there so
12 what I am saying isn't that you are not going to get
13 that kind of volume decrease because you probably
14 will. What I am saying is if we were to move forth
15 with the vitrification on Silo 3, you will have to
16 address that 17% sulfate issue with adding materials
17 significantly in large amounts of material.
18 Off gas issues and Christine identified these
19 within her slides and basically we identified the off
20 gas issues are more significant for the vitrification
21 and encapsulation technologies and the reason being --
22 well, there are a number of reasons depending on the
23 particular technology. One is that they operate at a
24 higher temperature which in and of itself can dry an
25 off gas controller and you are not going to have --

1 it's more of a temperature process such as cement
2 stabilization. The second one is, it can be related
3 to some materials that you are actually working with
4 such as a sulfur itself and that type of technology.
5 Finally on time to protectiveness and this is
6 quantitative at best, we are making a statement that
7 we think the time to protect this and the clean up
8 time would be most certain for cement stabilization if
9 that is not an absolute given. That would be based on
10 what the market tells us they could do, in other words
11 with the sulfur polymer encapsulation, they would have
12 to give us that type of specific data that they have
13 and again, the status of the commercial development of
14 these technologies as Christine spoke to you
15 concerning the industry experience, we think it is
16 more certain that we would get it done for cement and
17 again I want to emphasize again, that is qualitative
18 at best.
19 Reductions of toxicity, mobility or volume
20 through treatment -- in terms of mobility and really
21 what we're after there offensively is reduction and
22 the mobility of the RCRA metals mobility to below
23 regulatory limits or more importantly to be consistent
24 with the waste acceptance criteria and off site
25 disposal facility. I don't really see any distinction

among the alternatives there. If they function as designed, we can address that issue.

Volume, same discussion, I don't need to repeat myself on the volume reduction associated with vitrification. Cement stabilization is going to realize a volume and I've got 20% there which is in part Christine's discussion I think she said 20% basically or less as it applied to the dry waste, if it gets up to where the waste is wet that's where her comment about the fact that the waste or calcide was at 600 degrees which drove most of that water that was for the Silo where it was for dry waste, for Silo 3. It is also consistent with some of the information that has come back from the most recent treatability type testing of stabilization. We don't have the same degree of site or waste specific information for sulfur polymer or polyethylene encapsulation, but if we go look at the EPA literature on this thing, what it tells us is that we really should expect it to perform about the same as cement with you know a plus or minus set up around that and that was the source of information that Don presented last time. So, in this perspective, if you can address the uncertainty we have having to add the material to address the sulfate issue vitrification might perform better but again

1 there is that uncertainty introduced there and finally
2 from a toxicity perspective none of the treatment
3 technologies destroy any particular contaminant, that
4 is not something that you notice a distinction there.
5 Implementability is basically two types,
6 administrative implementability and technical
7 implementability. Administrative implementability
8 more or less speaks to the ability of a proposal
9 alternative to attaining any and all permits that we
10 have again implemented and I think really the
11 administrative implementability issue here is rather
12 we can get it or we say we can get it to, like can we
13 give it to NTS for instance or do we have to go to a
14 permanent commercial disposal facility and demonstrate
15 and meet all of that facility's requirements. It is
16 our judgement that to form that design, there is
17 really no distinction of any of the four alternatives.
18 In other words, we think that there is a basis for
19 saying that we get a treated material at the NTS for
20 starters and what is that based on and what is it not
21 based on. What it is based on is two things one is
22 discussions with DOE Nevada personnel on the
23 particular characteristics of this waste stream
24 combined with the where it would probably be disposed
25 of at NTS relative to their performance assessment

1 process and to say definitively that it is going to go
2 there, we've got to pass the performance assessment
3 which we have not done but what we do have is a fairly
4 significant discussion with those people as to the
5 ability to pass through that process and all
6 indications there are pretty strongly endorsed and the
7 fact that we can so that is one piece of information.
8 The second one is if you look at the ways that we have
9 been shipping to NTS and a radiological
10 characteristics of that waste stream, basically we
11 have already been shipping the waste materials to NTS
12 and they are in essence about the same or worse in
13 terms of radiological contamination which we are
14 seeing now and we are able to demonstrate that and we
15 can pass through that performance assessment process
16 and get it there so that is the basis for this
17 statement. The technical implementability I will go
18 into the order that it is there. Based on commercial
19 availability and the maturity of the technology, in
20 other words, how much is who went out and done this
21 successfully and how much of that has gone out and
22 failed in it. We believe a technical implementability
23 or our ability to go out and be successful is probably
24 most certain with cement stabilization and again it is
25 based on nothing more than the degree of industry

1 experience with waste that are basically of this type
2 trying to achieve these particular remediation -- that
3 is to mobilize and address this issue and again, that
4 is where Christine's slide showing a cement
5 stabilization is as demonstrated available technology
6 for stabilization of RCRA metal comes into play. We
7 think there is a greater uncertainty for the
8 encapsulation technology due to the lack of commercial
9 development. I am not saying it cannot be done. I am
10 not even saying it cannot be readily done. I am just
11 saying that the degree of development in this
12 technology is significantly behind where the cement
13 stabilization is and where does the certainty factor
14 come in? This cement stabilization is being
15 implemented successfully on a daily basis and the RCRA
16 waste stream facility doing exactly what we are asking
17 the technology to do here and there have been some
18 huge major failures at the DOE complex with the
19 technology which Christine is here to address and
20 basically the advantages of being this far down the
21 road in technology is hopefully you can have these
22 failures and see what is going on and apply those
23 lessons learned for future applications and that is
24 really where I guess the basis for this statement
25 comes from. As far as the vitrification is concerned,

1 we think that the principal technical uncertainty
2 associated with vitrification as a sulfate issue that
3 you have heard about, in other words it is the 17%
4 industry experience and in our experience what the
5 pilot plan says you have to get down to about 1-1/2%
6 and we believe that introduces significant technical
7 uncertainties as to our ability to do it at all but
8 certainly to do it in a timely fashion and anywhere
9 close to what you would call cost effective.
10 Costs, can we say what these costs are, and
11 what they're not because I know you guys have a lot of
12 concern about the stability of these estimates and
13 what these are are the numbers that we gave the IRT
14 and I would like to talk about that a little bit
15 because there is a way that I would ask you to view
16 these. These are based on the status or the
17 information, the best information that we have
18 available right now. The reality is that what it's
19 going to cost is what a vendor tells you it's really
20 going to cost when they bid back on it with a specific
21 process. This is our estimate incorporating certain
22 assumptions. What I really am not asking you to do is
23 accept that it costs 61.1 million dollars for the vit
24 compared to 25 million dollars for cement
25 stabilization. What I am saying, more or less is that

1 we have a basis for suggesting vitrification at some
2 level more expensive than cement yeah, that's cement
3 stabilization and what we think kind of validates that
4 a little bit is what the IRT said and the Corp of
5 Engineer has set. They did not suggest that there was
6 a basis for saying these were absolutely accurate but
7 they were asked to comment on the validity of it and
8 what they said was if you want to do better on these
9 cost estimates, you are going to have to dramatically
10 enhance the level of engineering design associated
11 with the process and significantly increase the level
12 of treatability or pilots guild testing associated
13 with that and for the information available at this
14 time there appears to be reasonable so what I am
15 saying with that is there appears to be reasonable
16 factor basis for saying that vitrification is more
17 expensive. I don't care if you walk away feeling that
18 it was 10 million more or 30 million more, just that
19 there is a basis for saying that. The Corp of
20 Engineer in their draft value engineering reports
21 suggests that implementation or cement stabilization
22 in Silo 3 could be down significantly less expensive
23 than the vitrification. Since we are really at the FS
24 stage of the process which requires more of a
25 magnitude (inaudible). We don't have the same level of

1 site or basis of specific information to the
2 encapsulation technology but again if we go to the EPI
3 reference material that Don worked with last time,
4 basically they suggest a cost that should be
5 comparable to cement. Okay, those are our thoughts on
6 7 of the 9 cercla criteria. Where are we and where
7 are we going, I ask you to kind of develop your
8 thoughts and you can hit me with questions or thoughts
9 or whatever else you want to hit me with tonight on
10 that but particularly I would like you to kind of
11 evaluate what I have said and whether you buy it or
12 not and please feel free to get back with Gary
13 questions and comments so that we can consider them
14 for the next workshop and again, what we intend to do
15 is to bring forward to you in the next workshop what
16 we think we should do on Silo 3.
17 Now, having said that, I'm going to tell you
18 what we think we should not move forward on and that
19 is vitrification and let me tell you why and it
20 basically derives from balancing the criteria that we
21 have presented here today. We think that given the
22 sulfate issue for Silo 3, it introduces a level of
23 uncertainty in terms of our ability to implement this
24 that is greater than the other stabilization and
25 encapsulation alternatives. The number one

1 significantly higher in certain facts and we think
2 that is backed up with DOE and the industry's
3 experience. Secondly, again, I wasn't asking you to
4 accept the 61.1 million versus 25 million but I am
5 asking for a percentage that there is a basis for
6 saying vitrification is more expensive and finally
7 there do appear to be stabilization and encapsulation
8 alternatives out there that we have a basis for saying
9 we will readily meet the remedial action objectives
10 probably the basis of the technical and
11 implementability is more certain and that is the basis
12 for saying it can be done probably quicker and
13 cheaper. That, in a nutshell is kind of our basis for
14 saying we are probably not going to propose the duty
15 of vitrification when we come to you in July. We can
16 go through that in more detail if you would like. I
17 will be up here and we can talk about the details
18 behind what I just gave you, a very summary level on
19 any of these oversheets or statements but that is what
20 we are not, probably not going to do in July. What we
21 are going to come to you with remains to be seen and
22 that is what I would like to invite the feedback from.
23 MR. STEGNER: Thank you very much. For the
24 next 35 or 40 minutes or so, let's go ahead and do
25 questions and answers to the panel of experts up here

and as I said, Christine, if a question is addressed to you and you want to refer it to the gentleman from Brookhaven or Earl or whomever, feel free to do that. Following that has been our case in the past we are willing to stick around and talk informally as long as you guys want us to and since there is, you know, a lot of displays here, a lot of topics for discussion here in the back of the room, we will be available. Let's go ahead and do the question up until around 9:00 and then we'll stick around and if you have any other questions, we'll go through those. Gene, you had your hand up first.

MR. GABLONOWSKI: I have a question for the people from Brookhaven and I would like them to comment on the nature of the off gases and the polyethylene encapsulation process that was identified as the disadvantage here, I would like for them to comment on that, the nature of those gases, what they are and whether there is really a problem.

MR. LAGERAAER: My name is Paul Lageraaer and I'm a chemical engineer. We consider polyethylene encapsulation a low temperature process. Overall the temperature, polyethylene melts at about 120 degrees C. Typically your process is about 30 degrees below that and that is a typical temperature for the average

1 polyethylene that you might be using so if you are
2 processing 150 degrees, if there is any water in the
3 waste, that has to be removed. 150 degrees, any water
4 would have to come out at 100 degrees. As far as the
5 contaminants, it is a low temperature process and
6 there are no concerns for off gases. You just have to
7 design the system such that if there is any excess
8 moisture in there that needs to be removed. You might
9 have an extreme situation where there is moisture
10 while they are in the process and there is a screw,
11 simply an extruder, it's just a screw that goes
12 through the barrel and is to convey the material
13 through and there is an area there where the screw you
14 would pull back and you can remove any polymer. As
15 far as contaminants go, metals or anything like that
16 but since the temperatures are so low you don't have
17 a concern for any of the metals or the contaminants
18 being in the off gas stream.
19 MR. GABLONOWSKI: So the contaminants, the off
20 gases are primarily water?
21 MR. LAGERAAER: Right.
22 MR. GABLONOWSKI: And the second question deals
23 with the commercialization issue. As I understand
24 commercialization issue refers to using these
25 processes on waste products, not production scale work

1 on melting polyethylene and extruding material that
2 will be in essence through a very similar --
3 MR. LAGERAAER: Correct, as far as that goes,
4 there is no microencapsulation being operated right
5 now.
6 MR. GABLONOWSKI: On waste products.
7 MR. LAGERAAER: On waste products. There is
8 an extrusion process being led across the country for
9 processing polyethylene into creeks. It is just using
10 it instead of feeding polyethylene mixture, you feed
11 the waste water and it comes out the other end. It is
12 the polymer completely surrounds the waste material.
13 Environcare of Utah is currently using the same
14 system. It's the same extruder that's used for the
15 microencapsulation for the macroencapsulation. At this
16 time they are just putting in the pure polyethylene in
17 one end and out the other end. It is just the multi
18 polymer without the waste encapsulation.
19 MR. MOSKOWITZ: Let me just state one item in
20 here though, the state of Utah and the Environcare
21 submitted a licensed application to start
22 microencapsulation. Some time this fall they will
23 have commercial microencapsulation at that site. I
24 mean I would extend an invitation some subset of the
25 (inaudible). We have a commercial scale on the

1 microencapsulation and if you would like someone to
2 visit that facility, we would welcome a visit at any
3 time.
4 MS. LANGTON: When I put off gases as a
5 disadvantage on that slide, what I had in mind was
6 more than nature of the Fernald waste. It is a very
7 fine particulate material. I did see the particle
8 size distribution of one of the characterizations and
9 the particles are less than 100 micrometers typically
10 so I was not really -- the off gas handles gases,
11 water vapors, other gases, but it also handles
12 particulates in the process where fine powder are
13 mixed with the polyethylene material as you will see
14 in the back. Without water or something else sort of
15 glue down the fine particles, there is a potential for
16 particulates, quite a few particulates in the off
17 gases so the type of waste that you would see then
18 would be heppafilters or filters that would have to be
19 changed out. Now, again the same thing is true, it is
20 probably less true for the sulfur because the waste is
21 pre-heated and can be added to the molten sulfur but
22 something like a cement process where the waste could
23 be wetted to keep the dusting down, might have an
24 advantage. I did not go into that kind of detail but
25 it is something that you might want to consider and

1 off gases, I did not mean it to imply gases only.

2 MR. STEGNER: Vicki Daslund, do you have a

3 question?

4 MS. DASLUND: You were saying that the

5 waste form has to work with the system in the

6 environment where the disposal occurs. What would

7 happen with any or all of these processes if you, if

8 we treat the waste and we never do get it off site and

9 it is no longer being left in an environment, what

10 would happen in the environment, with no waste?

11 MR. LANGTON: I would, if I had to select

12 a waste form for disposal here on the site, I would

13 have to think about it in terms of other than what I

14 have been thinking about it. Again, I would look at

15 what I was trying to stabilize and there are, what it

16 is is parts per million, a few parts per million of

17 four toxic metals plus the radio nuclei in Silo 3 and

18 those radio nuclei are present in very low

19 concentrations. Now, I don't know enough about your

20 site to know if you have on site disposal of material

21 that is similar to that or not. I really just don't

22 know, but the overall system would have to be designed

23 to provide stabilization for those four metals and

24 there are about four radio nuclei of concern. I can't

25 tell you which material would be better or worse. In

1 my opinion of vitrified products made into gems, it
2 might be the lowest leaching in your environment here
3 at Fernald but that does not mean that the other three
4 types of waste forms would not be acceptable. The
5 lowest leaching and what is acceptable are two
6 different issues so the criteria would have to be set
7 up and the materials evaluated against those criteria
8 plus the overall disposal system would have to be
9 evaluated. West Valley and Savannah River are
10 disposing of cement waste forms with much higher rates
11 rating of nuclei loadings, different set of radio
12 nuclei and a different set of chemicals on site in an
13 environment that is similar to this. But, the overall
14 system, with the landfill designed, we've got concrete
15 vaults and clay caps and a drainage system that will
16 be maintained for several hundred years or a hundred
17 years and then should perform in the future after that
18 and even if the material is totally degraded, the
19 leaching into the ground water, it is all modeled in
20 our performance assessment and our materials and our
21 landfill disposal in past or performance assessment
22 evaluation.
23 MS. DASLUND: Terry, will our feasibility
24 proposed plan look at that question at all as far as
25 the disposal site?

1 MR. HAGEN: Yeah, we can do that. I don't
2 know if this is going to address your comment but all
3 of the alternatives that we intend on looking at in
4 detail involved off site disposal.
5 MS. DASLUND: I understand that, you make
6 a choice of treatment type and then politically things
7 change. We may not have chosen the best waste form.
8 MR. HAGEN: But I don't think we would be
9 proposing to start until we had the source or location
10 nailed down and in essence the approval to go. I
11 think we would demonstrate that and if I could kind of
12 draw an analogy to you, we are not treating any of
13 this waste. I would suspect that if we were to lose
14 permitted commercial disposal facilities before we
15 started implementing that remedy, we would want to
16 revisit the treatment. I don't see this as being any
17 different. We will present to you alternatives that
18 are alternatives and that includes treatment and
19 disposal and right now all of the disposal options are
20 off site and we would not start implementing that
21 remedy until we had a definitive assurance that it had
22 a home and then if something changes in the outset and
23 changes our ability to implement the remedy selected,
24 so you kind of go back.
25 MS. DASLUND: If that were to occur, we

1 would reopen the rod then?

2 MR. HAGEN: Well, I think you would have to

3 because you could not implement the remedy and the

4 remedy is not just the treatment, it is the disposal

5 option identified as well. It is a package deal and

6 if you can't do it all, Jim, am I out of school here

7 on that?

8 MR. SERIC: That's correct.

9 MR. GABLONOWSKI: On this salmon colored sheet,

10 could you be a little more detailed on what the Hugh

11 A failures were and the sensitivity from the

12 stabilization process. Is this a touchy business or

13 what specific failures of quality assurance --

14 MS. LANGTON: Well, since the first two are

15 from Oakridge, I will let Mr. McDaniel speak to that.

16 Where is he?

17 MR. MCDANIEL; Well, Gene, the hugh A

18 failure was a people just completely ignoring all good

19 QA. I mean they just ignored Hugh A. There was no

20 operator training. It was scheduled driven rather

21 than good QA and good QC. Now, what was your second

22 question?

23 MR. GABLONOWSKI: Well, for all three of you,

24 we've got two Oakridge and one Rocky Flat GA.

25 MR. MCDANIEL: Basically the attitude was we

1 are just doing cement. Anybody can do cement. It is
2 a low tech thing. We don't need good QA and that was
3 a mistake, you do need good QA process in order to
4 prevent the vitrification for the sulfur. You must
5 have good QA. The operator must understand that if
6 they are out of spec, they stop the plan until they
7 the condition is rectified. You will not be
8 production driven.
9 MR. GABLONOWSKI: Okay, now, on the Heneford
10 side, on the 183 basis, this was a fore plan in their
11 review. What happened was a commercially material
12 Sorbon (inaudible) was used to solidify the 183H basin
13 and the 183H basin which were all of the waste
14 material from the end reactor fuel then, in other
15 words, Fernald (inaudible) to Heneford it was
16 fabricated to only to do afterward on the 183H basin.
17 It was neutralized and the sludge settled out and it
18 was high solur nitrate sulphate and it was solidified
19 using this commercially valued material. The
20 requirement was that it get hard and it passed the
21 TCLP. There was no long term durability requirement
22 at all. Had the individual that reviewed the test
23 plan, anybody who had any knowledge at all in cements
24 and sulfates could have looked aside. You have
25 sulfates in your waste solution and you have a cement

1 that is high in tricalcium aluminate which means the
2 potential for expensive mechanisms are higher. These
3 mechanisms do not happen overnight or the next week.
4 They occur next month and in some cases even a year
5 and what happens was you have rain and that involves
6 a volume increase and they cracked and again there was
7 a QA failure on this because QA should have said this
8 should have been reviewed and evaluated and it was
9 not.
10 MS. LANGTON: I looked at some of the
11 material at Oakridge on some of the K-25's -- K65
12 films that did not set and I looked at some of the
13 Rocky Flats material that did not set. Rocky Flats
14 was trying to carry out just solidification, turned
15 their waste from solid to a liquid and Oakridge was
16 trying to do metal stabilization and the two failures
17 that I looked at forgot to put the cement in. Okay,
18 Oakridge had a problem with their delivery of fly ash
19 and cement. The Silos looked the same. When the
20 delivery trucks came they hooked up their pneumatic
21 connections with whatever silos was open and pumped in
22 whatever was in the truck. So that is a rather
23 serious QA failure. At Rocky Flats, the objective
24 there was again just to solidify salt waste. The salt
25 waste was a mixture of spray dried little round salt

1 conglomerates and super saturated hot salt solution.
2 It was all mixed in, it was all poured into a plastic
3 bag and a cardboard box and some cement was thrown in
4 more or less. Cement was not an important part of the
5 process because most of the solidification took place
6 because the hot salt solution cooled and as it cooled,
7 the salt crystalized. The excess water was allowed to
8 evaporate off so the cement was not an intrigal part
9 of the process except to serve as a heat sink so the
10 overall package would pass the oxidizer test being
11 exposed to a flame for ten seconds I think so in both
12 cases it was rather serious QA problems, fundamental,
13 not serious, just very fundamental and in the Haneford
14 183 basin, the wrong stabilization material was
15 selected for the waste.
16 MR. MOSKOWITZ: What is fundamental is the
17 chemical sensitivity or the stabilization process.
18 It's not only that the operator screwed up there is a
19 sensitivity in terms of the chemistry.
20 MS. LANGTON: Right, if you only put a fly
21 ash in, if you only put a mineral additive in the
22 waste that has no hydraulic properties which means it
23 does not react with water, all you get is more wet
24 sludge.
25 LOU _____: This form, if you look

1 at it not knowing any more detail about the waste
2 streams, the waste streams that you look at by far are
3 and large are pretty innoculous types of waste
4 streams. They are stuff and junk, but there are 11
5 experiments identified here and only five of the 11
6 were successful. Those are not very good odds.
7 MR. HAGEN: Can I speak to that? I'll tell
8 you what we are trying to do with that and that is to
9 focus on DOE and I assume everybody is going to focus
10 on some of the high profile projects and make sure
11 nobody is going to walk away feeling like there were
12 three things that were failures. If you actually want
13 to go to an industry and mark it and look at where
14 they are successfully applying those technologies on
15 a daily basis, I think the actual successes in
16 implementing cement stabilization with remedial action
17 objective and stabilizing metals that fail TCLP, I
18 think you could come up with probably a thousand
19 successes compared to these four or five failures.
20 The objects here was to focus on the high profile
21 thing that probably most of the people cannot
22 understand.
23 LOU _____; I would like to build on
24 that because I think the very key slide that Christine
25 presented, her last slide, none of these, there are no

1 doubt in my mind that people can take Silo 3 waste, go
2 into a laboratory on a small scale and make either
3 sulfur or polyethylene or a concrete block. The real
4 hard part which is probably going to affect the cost
5 is how do you get the stuff out of the Silo into some
6 kind of a plant, are you going to do a batch or
7 continuously or -- these processes differ in the
8 material handling consideration for getting the final
9 package out the door and I don't see any discussion of
10 how are we going to handle the material, is there any,
11 are there any differences because of the kind of
12 stabilization that we have selected? No doubt in my
13 mind in the laboratory you will be able to make good
14 concrete, good sulfur, whatever, good polyethylene,
15 whatever, but the real hard part is moving the stuff
16 from the front end of the process out the door.
17 MS. LANGTON: Well, I agree with you. I
18 mean, it's a very fine powder. Most fine powders are
19 moved to slurries or at least some wetted down to keep
20 the dust down, but it could be pneumatically
21 transferred also. There are a lot of ways to engineer
22 what you are talking about. It is critical to the
23 overall success of any process including the
24 vitrification process.
25 LOU _____: And it's going to be a

1 major element of the cost.

2 MS. AKGUNDUZ: The way the Silos 3 are
3 packaged is -- you are right, I agree with you,
4 getting the material out of the Silo 3 will be an
5 important as the treating waste to be able to disclose
6 it. The way the RSP is going to package the vendor
7 who has the treatment process is also responsible for
8 getting the material out of Silo 3 so it may sound
9 like as if we are just deferring the responsibility
10 but knowing that expertise lies with the vendor,
11 whether the treatment process or getting the material
12 out of there, we are packaging the RMP so that one
13 vendor is getting the material. They are responsible
14 for getting the material out of the Silo to get the
15 treatment done.

16 MR. MCDANIEL: Let me say a word about that
17 if I can. There is a lot of technology available in
18 the chemical industry and getting materials out of the
19 rail cars and this is where we at Oakridge want to and
20 we did find an awful lot of experience and good
21 engineering in it and this is a very, you are right,
22 this is a very crucial area. It is how you get it out
23 of the tank, but I think most of your chemical people
24 do ship bulk material by rail car and also to the
25 slurry transport association who pumps coal from place

1 to place in pipelines does have a lot of information
2 on it. I took a course under Richard Pank at Brigham
3 Young University who was an expert in the field.
4 LOU _____: We are working on DOE site
5 and a radiological --
6 MR. MCDANIEL: Yes, it sure does.
7 MR. STEGNER: Pam, did you have a question?
8 MS. DUNN: I have a couple of questions. You
9 keep talking about the industry comparisons but isn't
10 industry waste a little more homogeneous -- I mean,
11 didn't industry tend to mix so much crap together than
12 what DOE does?
13 MS. LANGTON: No, I don't think so. The
14 super funds site contain all kinds of mixtures.
15 You've got -- the waste that is in Silo 3 from my one
16 day here trying to understand what you have, I'll put
17 it in this perspective, rocks for mind and ore was
18 extracted from the rocks so the junk rock was put into
19 mind tailing piles. The good ore was sent to a mill
20 where it was crushed up and a flotation process was
21 used to pull off really a density separation, heavy
22 from lighter phases. The waste at the mill is
23 milltailing, that's the same thing that was in the
24 rock, just crushed up into finer particles and
25 separated from the heavier ore, the uranium containing

1 phases. That concentrate was sent to Fernald. Now,
2 it did come from a variety of mines and probably from
3 a variety of mills. It was sent to Fernald. It was
4 dissolved in nitric acid. From the literature I saw
5 something that said up to 3 molar nitric acid so not
6 very strong and not really weak but medium strength
7 nitric acid and what is in Silo 3 is the stuff that
8 did not dissolve, the parts of the ore that did not
9 dissolve.
10 MS. DUNN: Is that the basis for all of the
11 thorium content then?
12 MS. LANGTON: Yeah, it is the thorium that
13 was in the rock -- well, no, that is not exactly
14 right. The uranium -- well,
15 MS. DUNN: I mean, industry would not have
16 the thorium content --
17 MS. LANGTON: No, but that is one
18 particular radio nuclei that would also form in the
19 form. Did not just form in the Fernald waste from
20 something you added here. Okay? But it is not a
21 particularly different from the waste material that is
22 generated in the mine or in the mill. It is quartz
23 sand, calcium sulfate that did not dissolve, some
24 phosphate material, iron, oxide, aluminum oxide but,
25 that was formed in your -- it did not dissolve in your

1 dissolver here at Fernald and then it was heated to
2 600 degrees C. to dry up all the water and to calcide
3 it. So it is not particularly different than other by
4 product waste and it does come from a mixture of ores
5 and a mixture or mills but I don't think it is
6 particularly variable, not in a big sense of how it
7 was generated.
8 MS. DUNN: If I could keep going, you talked
9 about the additives that you would have to do to vit,
10 Silo 3, what kind of comparison of amounts are we
11 talking about because you will have the additives
12 added to it to cement it, sulfur, whatever you do to
13 it there will have to be additives to it so ballpark,
14 I'm not going to hold you to the truth of it but how
15 much are we talking additives to bring down the
16 sulfates to this or additives to cement or additives
17 to the sulfur polymer --
18 MR. HAGEN: Let me go back and go the ones
19 that I think we have the most confidence in based on
20 the level of moisture in Silo 3 and that is where
21 cement stabilization technology, it looks like 20%
22 volume increase because of the additives going in
23 other cements or any one of the types of materials
24 that are consistent with that technology that
25 Christine talked about, it's probably what we can

1 expect and that is consistent with actual
2 treatability. We don't have that same degree of
3 assurance for encapsulation technology but again, the
4 EPA guidance suggests that it would probably be
5 comparable and now rather that is zero percent to
6 thirty percent, I cannot say until the vendor comes in
7 and does it same neck of the wood. Now, would some of
8 the original estimates, going back to let's say the
9 1994 days were, for reduction and actual waste volume
10 stuff going in versus coming out was about what, 49%.
11 That was before we identified this problem, the
12 sulfate issue. Now, that is probably --
13 MR. PAINE: On the vitrification process,
14 regardless of how many additives you add and stuff
15 like that, based on the nature of the material, you're
16 going to add to the material that we ship off site,
17 you will have less volume with the vitrification
18 process than you would with any one of these other
19 three processes. I think that is a given. Regardless
20 of what we have to do but you've got to remember how
21 we're getting a volume reduction with vitrification.
22 How am I doing it? I mean, I've got masses in there
23 somewhere, it went somewhere, right? So what we do
24 with vitrification is we raise it to a very high
25 temperature where we get the majority of lime

1 reduction is we drive off all of those sulfates,
2 carbonates, phosphates, which have a lot of mass and
3 stuff and we treat them in another system. It's not
4 like we don't treat them. Now, they don't go off
5 site, they stay on site and we either treat them with
6 the heppafilters which in some cases we have to
7 stabilize and we ship those off site or we generate a
8 lot of liquids that in this process we have to treat
9 those and you know, the majority of those go on over
10 to the AWWT and they treat them and it pumps off to
11 the water so we get a lot of particulate stuff in the
12 off gas system and stuff like that to get in trained
13 and those kinds of things and don't get down into the
14 scrubber system or the quench tower. I mean, that
15 whole system out there, you know, you go out and look
16 at is treating all that volume reduction that I'm not
17 shipping off site but that is still a large volume of
18 material and in a lot of cases it ends up and in come
19 cases it can end up with more volume, total volume you
20 have created with the vitrification process than you
21 did with some of these others. It's just, what you've
22 always been looking at would be proposing, this stuff
23 that actually blows off site and it gets final
24 disposition off site. Without a real recognition,
25 well, how did you get the dang volume reduction? I

1 got it sitting over here in another system but I am
2 dealing with it over here. It is not that it just
3 magically, you know, all of a sudden it is just half
4 the volume than it originally was -- but that's how
5 you get it.
6 MS. DUNN: I was not talking product here, I
7 was talking -- you say to vitrify you would have to
8 add so much stuff, you have to bring the sulfate from
9 7% down to 1% so you have to add ten tons of that
10 additive. Is it ten tons of something that will have
11 to be added also to cement or is it normally 5 tons
12 that have to be added to the cement?
13 MR. PAINE: No, what I tried to say, I think
14 whatever we added like from that standpoint for the
15 product that we are going to generate which is glass
16 and it's going to go off site, you are going to see
17 some sort of volume reduction there regardless of what
18 we did, in my opinion, even with the Silo 3 material.
19 UNIDENTIFIED MAN: I don't think you are
20 answering the question. There are other comparisons
21 that increase the volume with the cement and there are
22 some comparable increases in volume with the Silo 3
23 material with the polymer encapsulation or whatever if
24 you go into the work of the Silo 3 material with the
25 17% sulfate in it, you know, compare it to the volume

1 of the material that is in the actual waste, what
2 percentage of the additive do you have to add? I
3 remember a meeting where you were basically telling us
4 there will be about 20 to 1 waste load, 20 part added
5 to one part silo.
6 MR. HAGEN: Depends on what approach you took
7 like the original approach like I said, 17% to 1%,
8 that is pretty much the math right there. You've got
9 the 17% and a 1% pay --
10 MR. PAINE: Well, remember, we're adding the
11 additives with the -- the glass won't take the sulfate
12 above 1% so we have to drive all those off and we have
13 to treat those in another system and in the process of
14 driving those off, we have two phenomenon, we have to
15 control which we made a valiant attempt to control it.
16 One was the big foaming issue and we had a lot of
17 foaming with it and you have to control that.
18 Otherwise, it is very detrimental on the melter if you
19 have a very significant safety concern. And then you
20 have the salt where you have to get a sulfate layering
21 that occur where all of the juice that I've got in the
22 melter goes through that instead of being evenly
23 dispersed in there and you get isolated areas that are
24 very high in temperature which are very much
25 detrimental to some of the materials in the

1 construction that we've got so you're adding those
2 reductants to try and keep that foaming in control and
3 give the sulfates enough residence time in that hot
4 glass and stuff such that they can turn into gasses
5 and be off gas and I can treat them down to the off
6 gas system and that is the difficulty, you know, I
7 used it once, like putting too much soap in a washing
8 machine and they all start bubbling out of the washing
9 machine. You don't want to get into that kind of a
10 situation. You have to control that reaction process
11 very carefully or you can get into some very
12 significant problems. Plus it's just difficult to do.
13 MS. DUNN: There is a 20 to 1 load and you
14 all are going to work on this for next month, if it is
15 a 20 to 1, like Gene said, 20 to 1, 20 parts additives
16 to 1 part silo 3 to vit, what is that ratio to cement
17 the sulfur polymer to encapsulation, what is it for
18 all four alternatives? You have to have additives for
19 all of the alternatives. What I want to know is what
20 load or ratio is for all four and not just vit?
21 MS. LANGTON: I understand your question
22 and part of the reason it is so hard to explain the
23 answers is because each of the different additives has
24 a different density. The density for the additives,
25 the cement additives, has a number of 3 and that means

1 that equal amount of the cement weighs three times
2 more than water. The density of the polymer is 1,
3 about 1, it weighs about the same as an equal volume
4 of water so when you are asking for pounds of
5 additives, that is the wrong unit, I mean, it's an
6 okay unit it is just not going to give you a
7 comparison but what is the volume increase. If you
8 start out with 5,000 cubic meter of waste, how many
9 cubic meters of waste form are you going to get, okay,
10 and we are saying that you get a 20% increase so you
11 get 6,000 cubic meters of a cement polymer or sulfur
12 material and we think you will get -- well, you were
13 told you would get less, much less of the glass waste
14 form, okay, but when you were told that all of the
15 waste constituents that were lost in the off gas were
16 not counted so --
17 MS. DUNN: So, I guess my concern is, is this
18 a reason to not vit so I would like to see a
19 comparison.
20 MR. HAGEN: Actually that one is not a reason
21 not to vit. I tried to give it credit, if you will,
22 that is why I left the bullet saying you will get a
23 volume decrease for vit. I wanted to increase --
24 introduce the uncertainty but as far as if we were
25 going to ESD today and putting all this stuff in

1 writing, I would say in theory you can realize the
2 volume decrease for vit and a volume increase for
3 cement so that would not be a driver for going away
4 from vit, from the way I tried to present the
5 information. I don't know, I don't want to use the
6 term give credit to, but that is one where I think the
7 comparative analysis would favor vit the way we are
8 proposing to put the information forward.
9 JIM _____; I guess I want to
10 clarify something. I want to go back to the point,
11 Pam, you had like 5000 cubic meters or 20%, you would
12 come up with 6,000 cubic meters. Now, if you want to
13 vitrify the waste form, before you could vitrify it
14 and I believe that we have seen from the pilot plant
15 test where that shows the reaction is not a simple
16 thing and will lead to more than likely more failure
17 which we did and I think that we are just asking
18 reactants and we will be able to control the foaming
19 problems so it is going to be dilution is going to be
20 the only way you are truly and more than likely going
21 to get the vitrification process so if you had a 20 to
22 1 additive in the ratio, what would be your initial
23 volume before you started your vitrification. Now,
24 look at the number or 20 times that volume, I'm not so
25 sure you would start with before you vitrified. If

1 not you could cut that volume in half, you would have
2 half of that and I think your end product would still
3 be more for vitrification than if you had to dilute it
4 for 17%. I think the point that Pam is trying to get
5 at is you are going to start out to get the
6 vitrification of work, you would have to start out
7 with a much larger volume of material, 20 times more
8 and then maybe you can get it cut in half by
9 vitrifying it.
10 UNIDENTIFIED MAN: There is some secondary
11 waste streams so combined you still talking about ten
12 times as much than when you started with.
13 MS. LANGTON: But, the glass waste form,
14 it's a non-porous material. These other waste forms
15 do have some porosity so that is something, that is
16 one place where you get a volume decrease in glass.
17 The density of the glass, I'm going to guess, it is
18 again close to 3, 2.8 some number like that which is
19 in the same range as cement powder particles and I
20 don't think you want to -- the question is how many
21 pounds of additives because additives are putting all
22 different reasons, maybe to break down the sulfates or
23 do something which has nothing to do with making the
24 glass, what I think you are really interested in is
25 how much volume did I have to start with and how much

1 volume do I have to dispose of off site.

2 MS. DUNN: For all three.

3 MS. LANGTON: For all three and how you can

4 visualize the cement and the polymer and sulfur might

5 be if you take a jar of sand, just sand. The idea of

6 all three of these waste treatments besides and the

7 cement trying to carry out chemical reaction, that

8 would be beneficial, would be to coat those, separate

9 those grains of sand, a small distance, so you're

10 going to get a little more volume and fill the void

11 space in that jar of sand with binder and you're going

12 to separate all those particles so you will get a

13 little volume increase, we say 20%, I said probably

14 less than 20% so that's how you can visualize where

15 that number comes from and if the waste is wet, you

16 have water that is already filling those voids and

17 that depends on how much water you have. You may need

18 to add some more water and get a little more volume.

19 In Savannah River we really get less than 50% in our

20 wet waste in our end product compared to the

21 originals. The vitrification, since it is not porous,

22 about the same density as the cement and that mineral

23 additives, you get, you can concentrate the waste a

24 lot more if that were really possible if it did not

25 have the sulfate in there. If you were just

1 stabilizing for the four toxic metals and the radio
2 nuclei because of the radial sulfate, you cannot do
3 the concentration unless you add chemicals ahead of
4 time pre-treatment which you have never accounted for.
5 MR. MOSKOWITZ: Just a couple of things, that
6 is an extremely good question that you have asked. We
7 don't have the complete answer although we have some
8 of the answers in some of our report with the sulfur
9 and polymer and actually it is using the cement as
10 well as the polyethylene what you are adding is the
11 material used to stabilize the encapsulate. The
12 question though is in terms of the number of drums
13 that you are shipping from site A to site B and how
14 much increments you are adding because of the
15 materials used in the stabilization. We have some
16 report which look at the nitrate salt encapsulation
17 with Rocky Flats and I am asking the question in a
18 drum what percent of the material is waste and what
19 percent is encapsulation for example with polyethylene
20 you have about a 70% by weight waste and 30% by weight
21 encapsulation and about 300 kilograms per drum of
22 waste going out versus West Valley Cement, where you
23 have about 100 kilograms of waste versus the cement
24 stabilization and what that translates to in Rocky
25 Flats, again, we have not done this calculation for

1 Silo 3 and we can certainly do it but at Rocky Flats,
2 there was generated about a million kilograms along
3 with the nitrate salt and that translates into about
4 4,000 drums of polyethylene and about 15,000 drums for
5 West Valley Cement so you can calculate that number.
6 There is a volume increase and there will be a
7 difference across all four of the technologies in
8 terms of the numbers of drums which are shipped from
9 site A to site B.
10 MS. LANGTON: But again, you have to know
11 whether or not there is water. The West Valley waste
12 had water, it is a salt solution compared to a dry
13 solution so again, a large part of the waste is
14 removed and put through another process. I would say
15 all of the encapsulation processes would be about the
16 same results in the Fernald, especially for the
17 Fernald waste because it is insoluble. They are
18 insoluble residues from an acid dissolution process
19 that were then calcide heated to drive off the excess
20 water that came out of the dissolution process as a
21 sludge and then it was heat treated so has already
22 gone through a pre-treatment, probably two pre-
23 treatment, probably neutralized and then went through
24 the calcide to get it to to insoluble -- I don't want
25 to say sand-like form because the particles are much

1 finer than sand or what you normally think of it but
2 almost an earth form. It is very insoluble.
3 MR. CLASSON: What I would like to know the
4 difference between what it takes all four of a system
5 ready ships. And the cost involved there and the
6 time, time is money and so if we've got a system that
7 is slow and undeveloped, we are talking about very,
8 very uncertain times and time is money because we've
9 not got it nailed down so it looks to me like you need
10 to go with something that is proven and something that
11 is on a time schedule instead of, you know, we are on
12 a time schedule but it has to work.
13 MR. STEGNER: And I agree and that's a good
14 point. Lisa Crawford?
15 MS. CRAWFORD: I want to follow up on a
16 couple of Pam's questions and Marvin's questions, but
17 I need, somebody is going to have to sit down with me
18 and look at what I have written down because I don't
19 know if I can -- I need a chart or a graph maybe. I
20 think those work a lot better for some of us sometimes
21 that's got the 9, what do they call it criteria listed
22 down the side and probably before we get to state
23 acceptance and community acceptance we may need some
24 type of transportation line or a time line or
25 something fixed in there somewhere. Do you get where

I'm coming from and I need you to list cement stabilization solidification in one spot and I need polymer and sulfur and then I need vit. I tried to do it but I cannot figure out 4, 5 and 6. I cannot quite figure out whether I can put a check mark or an X on it. I am kind of lost in that range there.

MR. HAGEN: We used to put graphics like that, we used to put graphics just like that --

MS. CRAWFORD: Maybe that's where I'm remembering this from. To me I am really confused. Maybe nobody else in this room is but I am a little bit confused and I think that would maybe be helpful for us to see something like that but also and maybe the transportation and the time line may not be specific to the 9 criteria part of it, but maybe it needs to be a subset or something.

MR. HAGEN: Yeah, we can work on that.

MS. CRAWFORD: That would be really really helpful for some of us. That is my feeling and I am still just a little bit confused.

MR. STEGNER: Vicki and then --

MS. DASLUND: I have another request for another chart. I want to see a chart that compares all four of them with what constituents would be in the off gas and list them out, what things and then

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23 another chart. I want to see a chart that compares
24 all four of them with what constituents would be in
25 the off gas and list them out, what things and then

1 what would the health effects or environmental effects
2 of those be if they got out and did not contain them
3 and then list exactly how you would contain them,
4 whether heppafilters or --
5 MS. LANGTON: Particulates, the waste
6 itself would be in the off gas, the particulants of
7 the off gas and the contaminants that are in the waste
8 would be in the off gas in the same proportion that
9 they are in the waste so that you would, if the waste
10 is hazardous characteristically hazardous for toxic
11 metals, then the resulting heppafilter would not
12 necessarily would probably show that same
13 characteristic and have to be treated to meet land
14 disposal restrictions.
15 MS. DASLUND: So you are saying arsenic --
16 MS. LANGTON: Arsenic and chromium --
17 MS. DASLUND: Those would all be in the off
18 gas and the radioactive constituents would be in the
19 off gas.
20 MS. LANGTON: Yes, they are all present as
21 very fine particles which make up the waste. I don't
22 have any mechanism for leaving the selenium particles
23 in the waste and taking out the arsenic particles. If
24 the particles are all equally fine as far as I know --
25 MS. DASLUND: There is no new things

1 bidder did not have enough people. You can see that
2 in the photographs and, did not have enough cement
3 trucks and you can see that in the photographs and the
4 result, if you have seen the photographs, is a layer
5 cake effect and over the years things started leaking
6 out between the cracks because the low bidder did not
7 have the ability to do the job right. Now, I use that
8 as a pre-comment to this, it seems to me reading this
9 and the comments of this, that you have to -- the
10 engineer have to write bid the specification, they
11 have to write very tight specs to ensure that the low
12 bid is on a very specific guaranteed to work process
13 and I suggest that when they get ready to do that,
14 that they go back and get copies of the bid papers on
15 every one of those projects and find out what the
16 difference is between the successful ones and the
17 unsuccessful ones and then they write their bid papers
18 incorporating the safe guards that were the successful
19 projects and they avoid what comments they had over
20 here where things like well, they left the cement out
21 and other things that were poor quality control and
22 people were just standing there pouring concrete and
23 grinning and picking. Seriously, I think if you write
24 the specs right, then you will get the job right.
25 MR. STEGNER: Okay, let's take one more

1 question from Pam and then we'll break up into the
2 smaller informal groups and look at the displays and
3 some of the waste forms that we have in the back. Pam
4 go ahead.
5 MS. DUNN: This can be a question like a yes
6 or no but maybe the other one you might need some time
7 to get back to me but does the cost on the 61, 1
8 million and 25 million, does that include estimates
9 for retrieval?
10 MR. PAINE: Yes.
11 MS. DUNN: So you have started to formulate
12 some idea of what you think retrieval is going to
13 cost?
14 MR. PAINE: Yes.
15 MS. DUNN: What happens if the privatization
16 money is X'd out like the rumor on the hill? You
17 don't have the money to go ahead with the silo, does
18 that mean you just stop this fast track and continue
19 --
20 MR. PAINE: I cannot speak for Johnny. My
21 question is, I mean my thing would be to go to,
22 internally and also the DOE and we find what we have
23 currently allocated to keep it on track based on the
24 risk associated with the Silo 3 relative to other
25 risks on site. I think that is what I would do.

1 MR. REISING: I think we all agree when
2 looking at the site priorities, the silos are a number
3 one priority and that thing, if in fact we have a
4 shortfall in privatization funds. We don't realize
5 the 41 million for the privatization and as Don
6 indicated we would have to re-rack the place of
7 authority and basically come up with the money to move
8 forward in relationship to it and I think that we will
9 hopefully not have to take another operating fund from
10 our funds and pursue the privatization but I think we
11 have to, I am sure Jack will make that the priority
12 for the Silo 3.
13 MS. DUNN: Does that mean that the money is
14 set aside and we will work out of the budget for the
15 vit that might be shorted out that you can take money
16 from and figure out what you're going to do in order
17 to move -- if 1 and 2 get shorted, Silo 2 gets
18 shorted, you're going to --
19 MR. REISING: No, I think we may have to
20 take a look at the amount of money that we're going to
21 earmark toward both of those projects but I know that
22 the regulators will require us to move forward as
23 quickly as we can with both the ESK process for Silo
24 3 and also as we move forward on the rodemeter process
25 for Silo 1 and 2 based upon the negotiations that we

are presently in to make sure that we have adequate funds to move forward on a track and schedule that is acceptable to them so I don't think there is any shortage on anything. We will have to take the bag of money that we are left with for the end of the fiscal year and figure out the best way to incorporate the priorities and move forward and it may require scaling down on something but I think we will see the silo projects move forward.

MS. DUNN: The last thing that I have and Gary I know it has been a long night, what effect does this ESD and rod amendment have on our EIS since that is imbedded in OU4?

MR. HAGEN: Let me give you my draft answer and then I will get back to you. Basically the difference between 94 and now is that there has been a secretarial policy that says you can incorporate the NEPA values into the cercla process. We intend to follow that secretarial policy, in other words, if you go back to the EIS you will see a separate stand alone in part, although that has identified NEPA values.

MS. DUNN: (Inaudible).

MR. HAGEN: Well, yeah, but what I am saying is we are still going to evaluate all of those NEPA values in the revised documentation but probably what

you will not see is separate stand alone portions like you did in the original OU4 document that specifically in a set aside type fashion did an analysis of the value so I think in substance the answer is you will consider them, but you may not see the something that's called revised EIS. We have to -- in other words, if we make -- statements original on each of those NEPA values and the statements have changed, we will go back and update those statements to be consistent with the overall re-evaluation and the alternative.

MS. CRAWFORD: You can do that with --

MR. HAGEN: Yes, consistent with the secretarial policy and the draft part of the -- (inaudible).

MR. STEGNER: Lisa, you've got one more question?

MS. CRAWFORD: The list that is up here on this board on the salmon piece of paper, do we know if these were done internally or externally and if they were done externally, do we know who did the work so that they can get a big red X put by their name. I would like to know that information and the years and the dates and the time frame.

MR. HAGEN: We will get that for you.

MR. STEGNER: This concludes our meeting tonight. Thank you all for coming and be careful on the way home. Fill out your evaluation forms.